Asymptotic stability and instability of some solutions to the Stokes and Navier-Stokes equations

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Abstract

Asymptotic stability and instability of some solutions of nonstationary Stokes and Navier-Stokes equations with periodic rapidly oscillating data and the vanishing viscosity will be discussed. We give homogenized equations whose solutions determine approximations (leading terms of the asymptotics) of the solutions to the equations under consideration and estimate the accuracy of the approximations. These approximations and estimates shed light on the following interesting property of the solutions of the equations. When the viscosity is not too small, the approximations contain no rapidly oscillating terms, and the equations under consideration asymptotically smooth the rapid oscillations of the data; thus, the equations are asymptotically parabolic. If the viscosity is very small, the approximations can contain rapidly oscillating terms, and the equations are asymptotically hyperbolic. Asymptotic and homogenization methods are used to prove of the results. In particular, the results are applicable to some Kolmogorov flows.

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